Space Weather Technical Forecast

Issued on Saturday, 15 January 2022 at 01:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storm intervals today.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate in the last 24 hours. A M1.8 flare was observed around 14/0200 UTC from just over the northeastern limb. This was probably emitted by previous region AR2821, which is now emerging onto the northeast limb. There are currently eight active regions on the Earth-side, however no notable flares have been observed from these regions. However, a C3 flare did occur, peaking at 14/1339 UTC when a filament lifted off from the southwest quadrant, near AR2925, with a resulting CME. AR2924 remains the largest region, currently classified at Fso/beta, but has been inactive. The remaining regions are magnetically simple, small, weak and remain relatively stable.

The CME associated with the filament lift-off is currently not expected to be Earth-directed, instead it is expected to pass close to Earth. However, as confidence is low regarding the CME some weak CME influence is possible at Earth late tomorrow or early day 3 (17th).

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE and DSCOVR at L1 remained at slow-ambient levels, around 350 km/s, until the evening, then increased to become slightly elevated, ending the day around 430 km/s. Through the morning the density of the wind was near or slightly above average, then through the afternoon gradually increased to become above average. Total interplanetary magnetic field (IMF) strength, Bt, was weak to moderate through the morning, then steadily increased through the afternoon to become strong, peaking at 18nT around 14/2111 UTC. The Bz component was predominantly positive through the morning, then became strongly negative through the afternoon, reaching-17 nT at 14/2111. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0), then increased through the evening to reach G1/Minor Storm (Kp 5) level between 14/2100-2400 UTC. These changes in the solar wind parameters indicate the imminent arrival of a HSS from CH44.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at background levels, temporarily reaching moderate levels of 165 pfu at 14/1545 UTC. Electron fluence remained well below the Active threshold (1e8 integrated pfu), with 1.56e6 integrated pfu recorded at 15/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Moderate, and further C-class or M-class flares are anticipated to continue from the new active region appearing across the northeastern limb. Another region is also expected to rotate on from the far side, within the next two days, and this could also increase solar activity.

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Met Office Space Weather Technical Forecast

Solar Wind / Geomagnetic Activity: No Earth-directed CME's are currently expected, although one CME is expected to pass close to Earth late tomorrow or early on day 3 (17th). The solar wind is expected increase through today, once Earth fully connects to the HSS from CH44, becoming strong with speeds 600-650 km/s. The HSS influence is then expected to gradually decline from day 3 (17th) onwards. G1-G2/Minor to Moderate Storm (Kp 5-6) conditions are expected initially, then decreasing Unsettled to Active (Kp 3-4) later today and through tomorrow, but with further G1/Minor Storm intervals likely, especially during the coming UTC night. Geomagnetic activity is expected to decline Quiet to Unsettled (Kp 2-3) for days 3 and 4 (17th and 18th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at predominantly background levels. The high energy electron flux (greater than 2MeV) is expected to start at mainly background levels until after the arrival of the HSS related to coronal hole 44. The flux is then likely to become Moderate to High through tomorrow (16th), and persist at these levels. The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold at first, then increase through day 2 (16th), and then probably reach the Active threshold during days 3 and 4 (17th and 18th).

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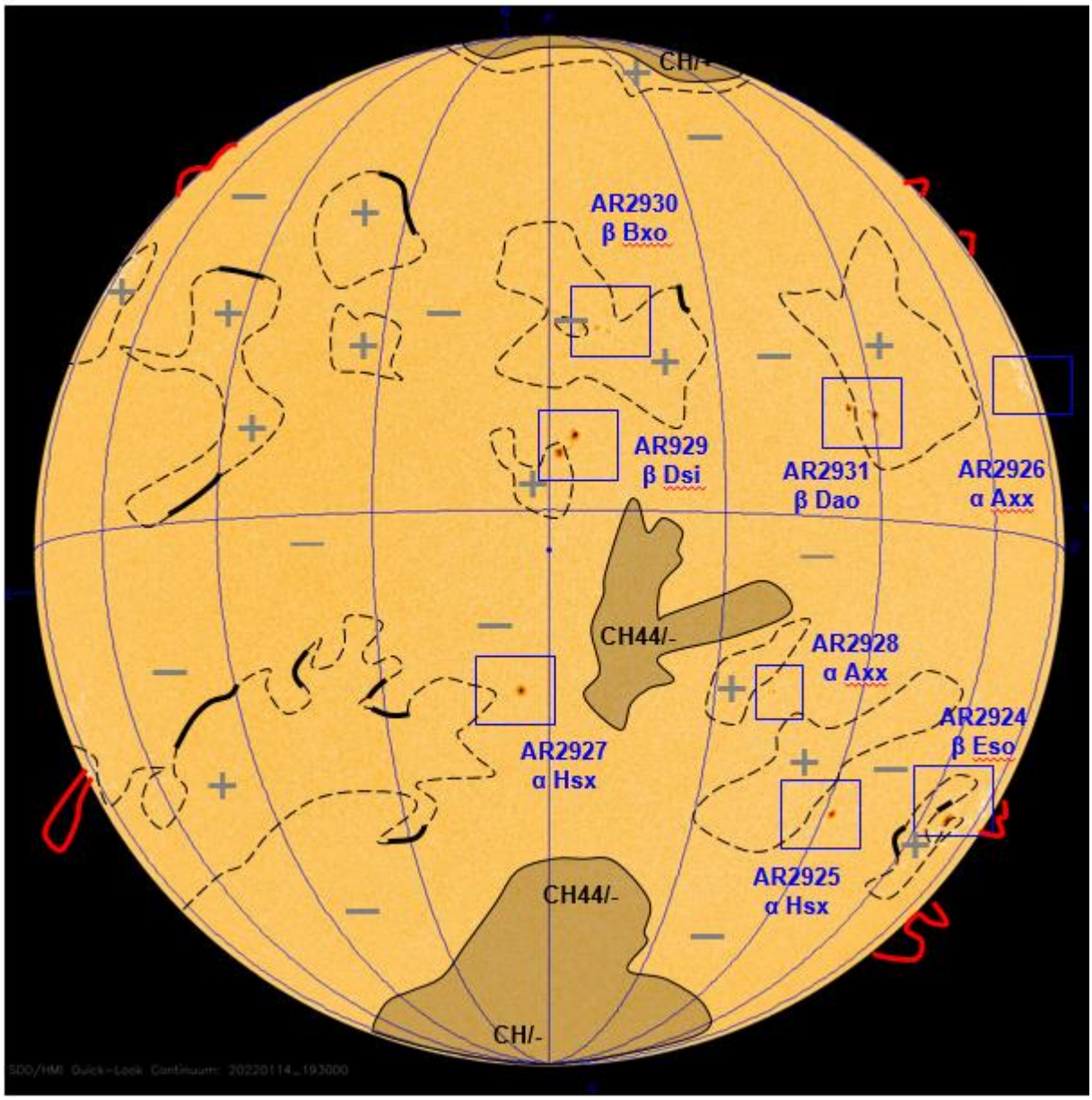
Figure 1. Solar Analysis Valid 14/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

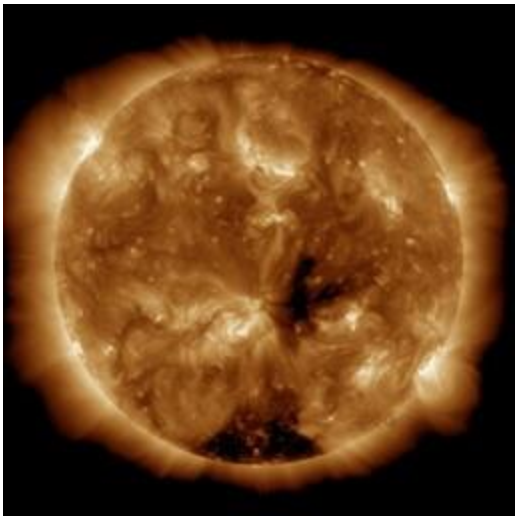
No Earth-directed CME's are currently expected, although the CME associated with the filament lift-off yesterday afternoon, in the southwest quadrant near AR2925, is expected to pass close to Earth late tomorrow or early on day 3 (17th). As confidence is low regarding this CME, there is a chance of weak CME influences at Earth, although these are likely to be masked by the effects of the HSS.

The solar wind is expected increase through today, once Earth fully connects to the HSS from CH44, becoming strong with speeds 600-650 km/s. The HSS influence is then expected to gradually decline from day 3 (17th) onwards.

G1-G2/Minor to Moderate Storm (Kp 5-6) conditions are expected initially, then decreasing Unsettled to Active (Kp 3-4) later today and through tomorrow, but with further G1/Minor Storm intervals likely, especially during the coming night and then to a lesser extend through Sunday night into day 3 (17th) due to possible weak CME influences. Geomagnetic activity is expected to decline Quiet to Unsettled (Kp 2-3) for days 3 and 4 (17th and 18th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	100	60	10	1
Strong	G3	No	10	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest SDO AIA 193 showing coronal hole 44.



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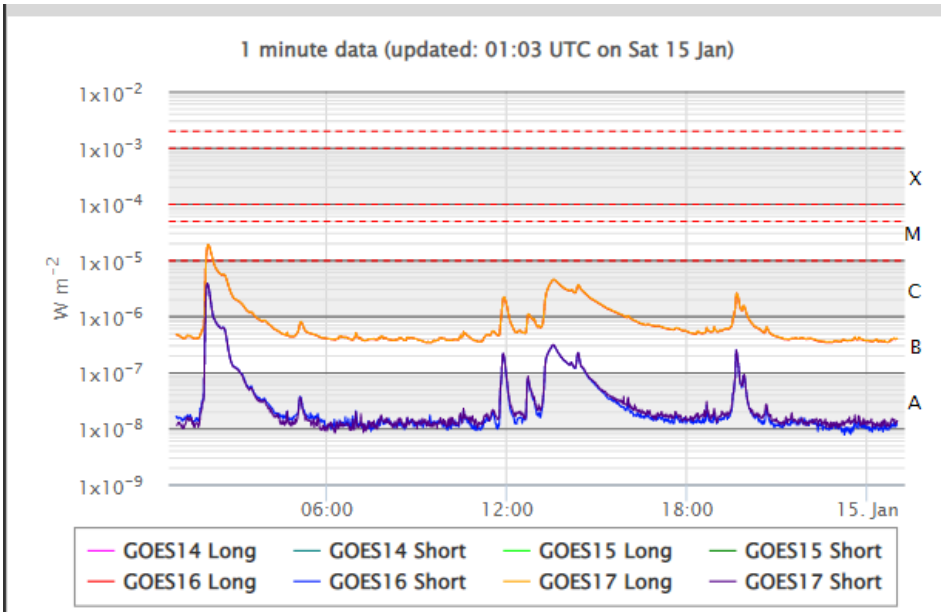
Radio Blackouts - X-Ray Flares:

Solar Activity is currently Moderate with several C-class flares observed recently and the M-class flare early yesterday. There are currently eight active regions on the Earth-side, however no notable flares have been observed from these regions.
There are eight sunspot regions; AR2924 is inactive and remains the largest region as it approaches the southwest limb horizon. AR2925, AR2926, AR2927, AR2928 and AR2930 remain small, weak and simple, with AR2928 now barely visible. AR2929 has developed slightly, with some intermediate spot and linking penumbra between the two main spots, and is now Dsi/beta. AR2931 continues to show some limited growth over the past few hours. A new region, probably ex-2821 (the source of far-sided flares in recent days), is currently emerging across the NE limb horizon.

A further large far-side sunspot (ex-AR2918) is also likely to rotate onto the disc within the next two days. This brings an increased chance of M-class flares (R1/R2 Blackouts).

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	30	30
Very Active	R3 to R5 X Class	No	5	10	5	3

Figure 3: Previous 24 hours GOES-16 x-ray flux activity, with the M-Class flare from the region which is currently rotating onto the northeast limb.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly at background levels, just temporarily observed to reach moderate levels over recent days. Flux levels will remain below the alert level (1000 pfu) until after the arrival of the fast wind of CH44 today. The flux is then likely to become Moderate to High through tomorrow (16th), and persist at these levels.

The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold at first, then increase through day 2 (16th), and then probably reach the Active threshold during days 3 and 4 (17th and 18th).

The Met Office REFM output is currently giving reasonable guidance, showing the fluence gradually increasing whilst remaining below the Active threshold, during the first 3 days of the forecast period. However, the increase in fluence is expected to be more marked through day 3, with the Active threshold likely to be breached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	40	60	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 4: Met Office REFM model.

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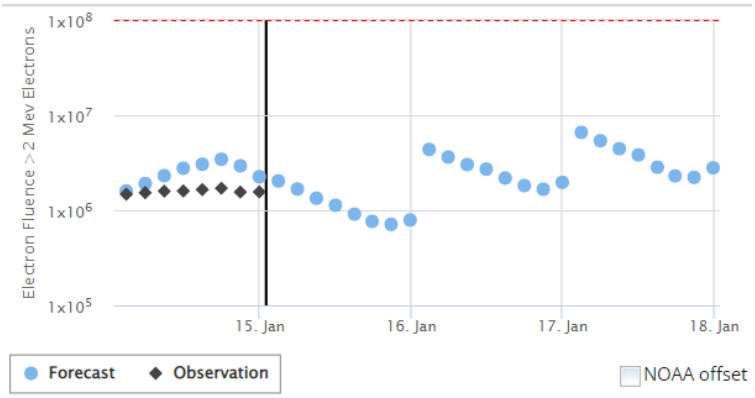

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